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**Subject:** Hillsboro Inventory Adjustment – 2007

**From:** Curt Kemppainen

**To:** Steve Underwood, Dick Coty

**CC:**

### **Background**

Approximately 200,000 MCF of additional gas was re-injected into Hillsboro Storage field during the 2006 Injection Season. An additional 200,000 MCF of gas was re-injected during the 2007 Injection Season. The additional gas is necessary to adjust Hillsboro's working gas volume to account for gas losses. Historically it has been shown that aquifer storage reservoirs have a history of losing a small percentage of gas to the formation. It will be necessary to add additional gas in future years based on reservoir performance.

In the early '90's Hillsboro Storage field capacity was expanded by drilling additional wells, injecting additional gas, and adding additional surface facilities. The field was designed to operate with base gas of 14.1 BCF and working gas of 7.6 BCF, for a total capacity of 21.7 BCF after the expansion. During the '93-'94 withdrawal year, the field cycled 7.6 BCF as designed. In the following years, the field steadily declined to a low deliverability of 2.6 BCF during the '02 – '03 withdrawal season. The decline in deliverability was eventually attributed to an injection metering error. The volume of gas required for re-injection was determined by an engineering study completed in 2004. Gas re-injection to return back to 21.7 BCF began in 2003 and finished in 2005. During the '05 – '06 withdrawal season, 6.7 BCF (corrected for meter error) gas was withdrawn. During the -06 – '07 withdrawal season, 5.9 BCF (corrected for meter error) was withdrawn. Total inventory delivered during the '06 – '07 withdraw year was limited by increasing H2S levels at the field.

### **Recommendation**

For 2007, it is recommended that a 200,000 MCF loss adjustment be made at Hillsboro. The following is a brief discussion of the reasoning for the recommendation.

### **Discussion**

The replacement of lost gas is critical for maintaining expected reservoir performance of gas storage fields. Companies who operate aquifer storage fields typically follow this very practice. The last revision to Hillsboro's working gas volume was in September 2004, when a 2.2 BCF correction was made. The revision was required following a detailed reservoir and facilities study of Hillsboro Storage Field, which identified the above-mentioned injection metering errors. An analysis of the hysteresis curve at Hillsboro has been performed, but due to the addition of 5.8 BCF of gas into the reservoir over a three-year span, the hysteresis curve is not stable enough to aid in determining a gas loss correction at this time. It is anticipated that after three years of cycling the reservoir at a constant working gas volume the reservoir will stabilize and the hysteresis curve will be helpful in quantifying gas loss volumes.

Neutron logs are a good reservoir monitoring tool, particularly for monitoring gas bubble changes that occur between spring and fall, but are not precise enough to quantify small changes in reservoir gas volume. Neutron logs measure total gas in a formation, and 200,000 MCF (only 0.9% of total inventory in the Hillsboro Storage Field) is simply too small for neutron logs to quantify.

The gas loss was estimated using the methodology which is outlined in Appendix I of M. R. Tek's textbook, "Underground Storage of Natural Gas – Complete Design and Operational Procedures".

For this calculation,

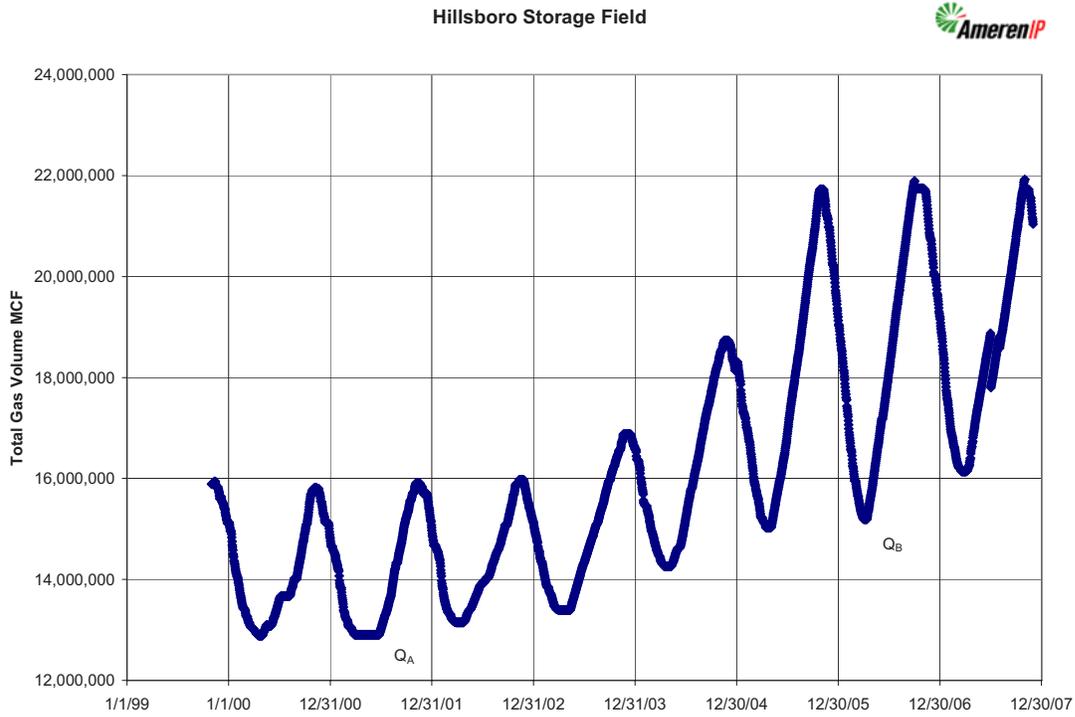
$Q_A = 12,904,021$  MCF (May, '01),  $Q_B = 15,194,272$  MCF (April '06)

$Q_B - Q_A = 2,290,251$  MCF. The average for 5 Injection – Withdrawal cycles is 458,050 MCF per cycle.

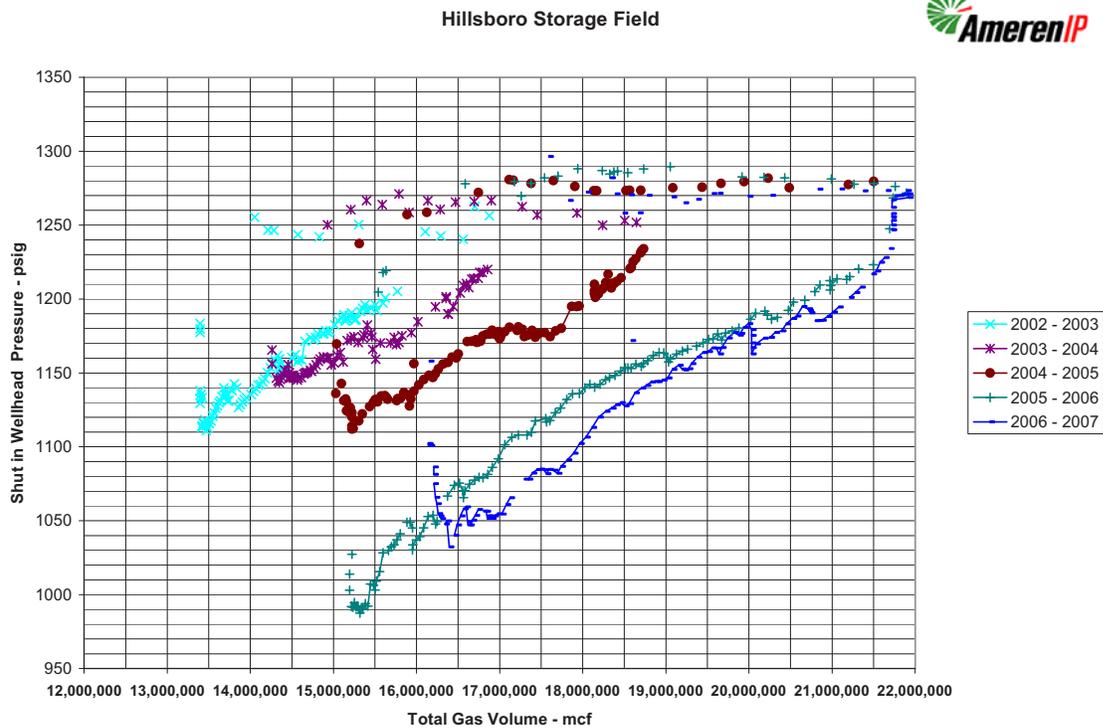
See the attached Hillsboro Gas Storage Field Total Gas Volume plot. The calculations are based on spring of '01 and spring of '06 data because in our judgment the spring '07 data is unduly influenced by H<sub>2</sub>S issues which caused us to discontinue withdrawal before the reservoir was fully cycled.

It is expected that as additional data is added to an ongoing reservoir model of the Hillsboro storage formation, and as further cycling of the reservoir stabilizes the hysteresis curve, using both the model and the hysteresis curve should substantially improve the determination of small gas inventory losses. In the interim, a conservative estimate of gas loss of 200,000 MCF for 2007 is indicated. This figure is approximately 2.5% of the working gas volume in the Hillsboro Storage Field. The hysteresis plot is attached.

### Hillsboro Gas Storage Field Total Gas Volume plot



### Hillsboro hysteresis plot



### Addendum

An analysis of reservoir performance was performed in the spring of 2008 to investigate what impact the injection of additional gas has had on the delivery performance of the field and also to update the gas volume vs time plot. Gas volumes were corrected for all known measurement variances as of the end of March, 2008.

The gas loss was re-estimated using the same methodology that was used previously and is outlined in Appendix I of M. R. Tek's textbook, "Underground Storage of Natural Gas – Complete Design and Operational Procedures".

For this calculation,

$Q_A=12,751,036$  MCF (May, '01),  $Q_B=15,112,277$  MCF (March, '08)

$Q_B - Q_A=2,361,241$ . The average for 7 Injection – Withdrawal cycles is 337,320 MCF per cycle.

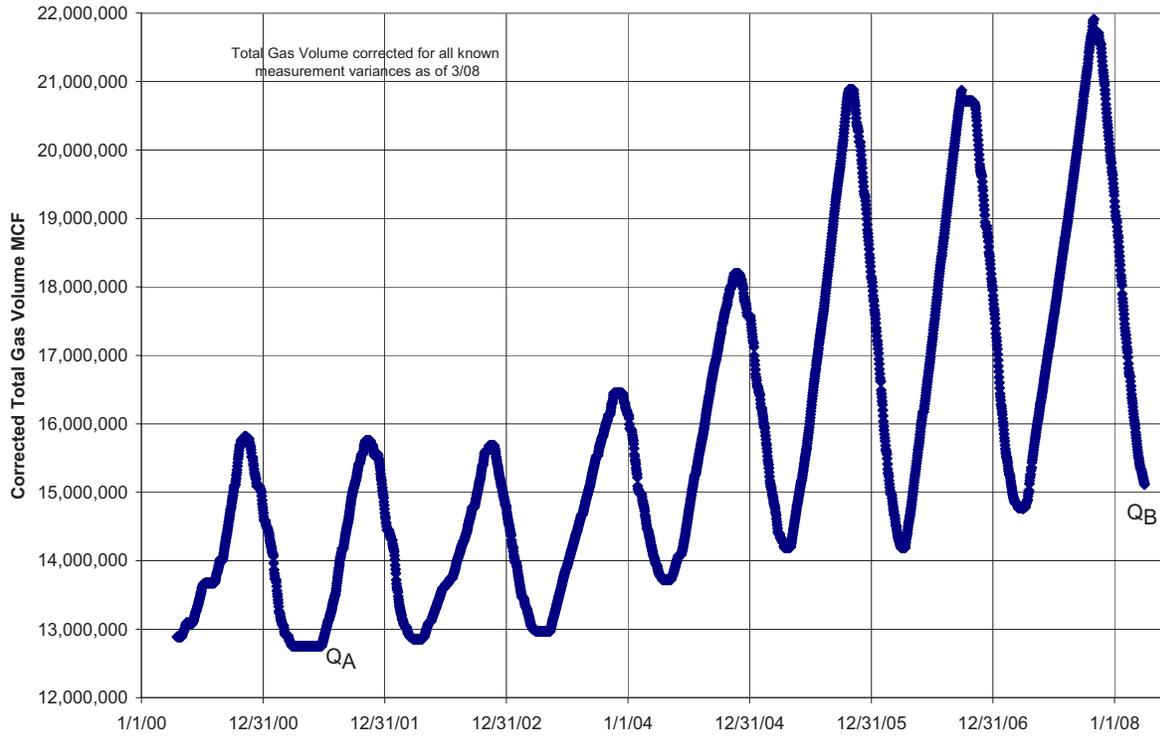
The decrease in estimated gas loss from 458,000 MCF to 337,000 MCF from the '01 – '05 analysis and the '01 – '08 analysis indicates that the 200,000 MCF gas loss adjustments that were made in '06 and '07 have made an impact on maintaining reservoir deliverability. See the attached Hillsboro Gas Storage Field Total Gas Volume plot below.

In addition, the field cycled 6.7 BCF in '05 – '06 and 6.6 BCF in '07 – '08. If AmerenIP had not injected an additional 200,000 MCF during the '06 and '07 injection seasons, it is reasonable to assume we would not have been able to withdraw roughly equal amounts of gas during the two seasons that are compared.

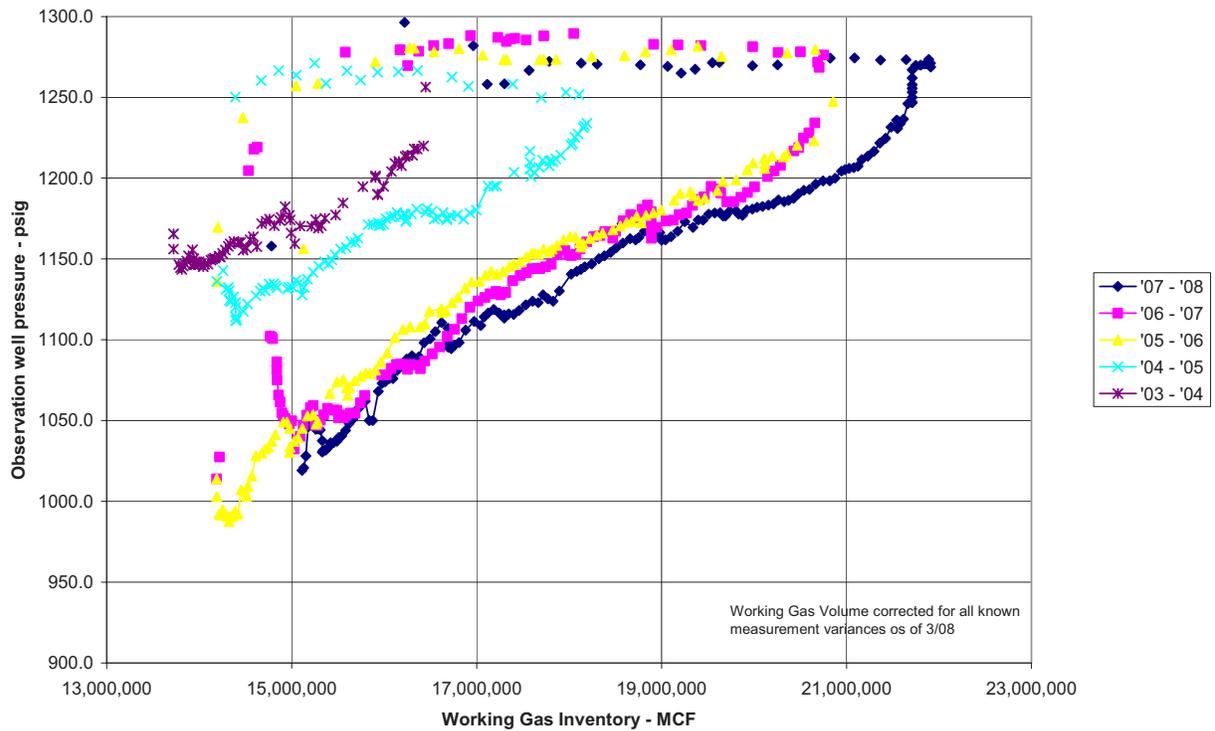
The hysteresis plots have been updated and attached also. They are not diagnostic due to the additional gas volumes that have been injected to adjust for metering errors.



Hillsboro Gas Storage Field Total Gas Volume



Hillsboro Storage Field



Response to the Ameren Companies'  
Twenty-First Set of Data Requests to Staff  
Docket Nos. 07-0585 – 07-0590 (Consolidated)  
Response of Staff Witness Eric Lounsberry

ICC Person Responsible: Eric Lounsberry  
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Business Address: Illinois Commerce Commission  
527 East Capitol Avenue  
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Business Phone: 217-785-5436

Data Request Ameren Companies 21.15:

On pages 57-83 of his Direct Testimony, Mr. Lounsberry discusses certain “past problems at Hillsboro.”

- a. Identify each of the “past problems at Hillsboro” that Mr. Lounsberry references that occurred after 2004.
- b. Identify any “problems at Hillsboro” that Mr. Lounsberry is aware of that occurred after 2004. For each such “problem” identified, provide an explanation of the nature of the “problem” and all documents Mr. Lounsberry relies on to support that explanation.

Response:

- a&b. As Mr. Lounsberry’s discusses in his rebuttal testimony, ICC Staff Exhibit 21.0, pages 50 – 53, Mr. Lounsberry’s reference to past problems at Hillsboro involved events that primarily occurred prior to 2004 and he has not seen a reoccurrence of those problems since 2004. However, Mr. Lounsberry did note that the management and supervisory levels were an issue in Docket No. 04-0294 and that his recollection was that Ameren did not hire additional storage personnel until 2005.

Response to the Ameren Companies'  
Twenty-First Set of Data Requests to Staff  
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Response of Staff Witness Eric Lounsberry

ICC Person Responsible: Eric Lounsberry  
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527 East Capitol Avenue  
Springfield, IL 62701  
Business Phone: 217-785-5436

Data Request Ameren Companies 21.22:

On page 77, lines 1598-1600 of his Direct Testimony, Mr. Lounsberry states with respect to the December, 2000 "Hillsboro incident": "The inability to make the basic discovery is a reflection of the poor management oversight that AmerenIP has over the safe, reliable, and efficient operation of its storage fields."

- a. Is it Mr. Lounsberry's position that the referenced "poor management oversight" remains a concern today? Explain the basis for Mr. Lounsberry's position and provide all documents he relies on to support his position.
- b. Is Mr. Lounsberry aware of any improvements in "management oversight" of gas storage at AmerenIP since December 2000? Explain the basis for his response and provide all documents he relies on to support his response.

Response:

- a. No. Mr. Lounsberry statement is not meant to reflect a current concern. See Mr. Lounsberry's response to Ameren data request 21.15.
- b. Yes. See Mr. Lounsberry's response to Ameren data request 21.19.